

APPENDIX C
CALIBRATION PRACTICES, CALIBRATION CERTIFICATES, HYDRAULIC OIL
SPECIFICATIONS, AND TEST SET-UP INFORMATION

CALIBRATION PRACTICES

ATTACHMENT 1

LABORATORY CALIBRATION PROCEDURES

The intent of this document is to ensure that all test equipment used in the SES laboratory is maintained traceable to an applicable NIST or MIL standard. Calibration is maintained on the following items used in the SES laboratory. Calibration is the responsibility of the lab manager.

- Load frames
- Calibration bars
- Pressure transducers
- Load cells
- Thermocouple calibrators
- Individual thermocouples (2 representative J & K type thermocouples)
- Measuring Equipment (including but not limited to ID and OD micrometers, dial calipers, standards, depth micrometers, and torque wrenches)
- Indicators
- Strain gage calibrator (MG 1550A)
- Data acquisition equipment used for calibrations (currently VXI voltmeter)

At this time no calibration is maintained on displacement transducers, strip chart recorders, electronic test instrumentation, or data acquisition equipment (except as noted above). These items are currently calibrated on an "as needed" basis as determined by the project manager.

RESPONSIBILITY

The above equipment shall be made available for calibration by the laboratory manager in a timely manner. Lost or missing items will be brought to the laboratory manager's attention. A calibration notebook will be maintained for each type of transducer. A summary of all calibrated items covered and the date of calibration will be maintained in the first section of each notebook.

It is the project manager's/technician's responsibility to ensure that each item used is calibrated before use. It is recognized that through error or oversight an item overdue for calibration will be inadvertently used. In such cases it will be noted and brought to the attention of the project manager and the laboratory manager immediately. The laboratory manager will ensure that the transducer is marked "out of calibration" and calibrated. Depending on the nature of the test that the transducer was used on, it may be necessary to compare the difference in calibration values (prior to and after calibration) to determine the actual values that would have been recorded if the transducer was calibrated just prior to testing.

CALIBRATION INTERVALS

All equipment calibrated for laboratory use shall be calibrated on an annual basis. If a calibrated item is overloaded or damaged it will be deemed out of calibration and brought to the laboratory manager's attention for repair or recalibration. If it can be determined that the calibration was not affected, it may be noted and placed back in service. The notation should be recorded and kept in the transducer history file.

IDENTIFICATION SYSTEM

Each item should be identified with a unique serial number.

Each item shall be marked with a calibration tag which shall include, but not be limited to, the following:

- 1) Serial Number
- 2) Calibration Due Date
- 3) Calibrated By
- 4) Operating Range (if not listed by manufacturer)

If the tag becomes illegible, it will be replaced with a new tag reflecting the identical information as the original.

CALIBRATION PROCEDURES

The intent of specified calibration procedures is to ensure that all items calibrated maintain traceability to either an NIST or MIL standard.

TYPES OF CALIBRATION

- Internal - those performed by SES employees (in-house).
 - 1) Equipment used to perform calibrations must be in current calibration.
 - 2) At least three shakedown (trial runs) must be made to full load before calibration.
 - 3) At least two calibration cycles must be recorded to full operating range of transducer. There must be at least ten ascending and five descending data points.
 - 4) A permanent record must be maintained of:
 - a) Equipment used (Serial numbers, system numbers, etc.)
 - b) Date calibration was performed
 - c) Date calibrating equipment was calibrated
 - d) Person who performed calibration
 - 6) The individual performing the calibration must sign the calibration certificate.

- 7) Instead of multiple calibration runs at different calibration values, a scaling factor may be mathematically determined to derive the new calibration values.
- External - those performed by vendors or transducer manufacturers.
 - 8) Must be traceable to applicable NIST or MIL standard.
 - 9) Individual data points should be recorded whenever possible.

HISTORY FILE

A history file will be maintained on each item calibrated. The history file will include, but not be limited to, a minimum of the past calibration sheets. The history file will be maintained indefinitely for each item. When an item is damaged beyond repair, it will be removed from service, removed from the calibration notebook, noted in the history file, and rendered unusable. The history file will be maintained for this transducer for a period of not less than 10 years.

PRESSURE TRANSDUCER CALIBRATION CERTIFICATES

Calibration Sheet

Manufacture: Dynisco		Model: PT130-1M			
Mfg. S/N: 05-17-007004		SES S/N:			
Output: 30mV		Transducer Range:	1,000 psi		
Calibration Readings				Calibration Statistics	
Applied Load psi	Reading 1 psi	Reading 2 psi	Reading 3 psi		
0	0	0	0	Zero Load Output (mv):	
200	200	200	200	Full Range Output (mv):	
400	400	400	400	80% Pressure Sensitivity (mv):	
600	600	600	600	Shunt Calib Sensitivity (mv):	
800	800	800	800	Input Voltage: 10Vdc	
1,000	1,000	1,000	1,000	Max Load @ vdc:	
				Max Load @ vdc:	
				Shunt #: 801.0	
The above transducer was calibrated using a Chandler Dead Weight Tester S/N 21333 calibrated on 22 May 00 by an independent testing laboratory and traceable to N.I.S.T. Standards					
SES Rep: <i>Napoleon Douglas Jr.</i>			Date: 24 May 00		
Signed: <i>[Signature]</i>			Recall: 24 May 01		

*Note: Shunt # = (Shunt Calib Sensitivity/Full Scale Sensitivity)*Tranducer Range

Calibration Sheet

Manufacture: Dynisco				Model: PT130-1M	
Mfg. S/N: 05-17-007005				SES S/N:	
Output: 30mV				Transducer Range: 1,000 psi	
Calibration Readings				Calibration Statistics	
Applied Load psi	Reading 1 psi	Reading 2 psi	Reading 3 psi		
0	0	0	0	Zero Load Output (mv):	
200	200	200	200	Full Range Output (mv):	
400	400	400	400	80% Pressure Sensitivity (mv):	
600	600	600	600	Shunt Calib Sensitivity (mv):	
800	800	800	800	Input Voltage: 10Vdc	
1,000	1,001	1,001	1,001	Max Load @ vdc:	
				Max Load @ vdc:	
				Shunt #: 825.0	
The above transducer was calibrated using a Chandler Dead Weight Tester S/N 21333 calibrated on 22 May 00 by an independent testing laboratory and traceable to N.I.S.T. Standards					
SES Rep: <i>Napoleon Douglas Jr.</i>				Date: 24 May 00	
Signed: <i>N. Douglas</i>				Recall: 24 May 01	

*Note: Shunt # = (Shunt Calib Sensitivity/Full Scale Sensitivity)*Tranducer Range

Calibration Sheet

Manufacture: Dynisco				Model: PT130-1M	
Mfg. S/N: 05-17-007006				SES S/N:	
Output: 30mV				Transducer Range: 1,000 psi	
Calibration Readings				Calibration Statistics	
Applied Load psi	Reading 1 psi	Reading 2 psi	Reading 3 psi		
0	0	0	0	Zero Load Output (mv):	
200	200	200	200	Full Range Output (mv):	
400	400	400	400	80% Pressure Sensitivity (mv):	
600	600	600	600	Shunt Calib Sensitivity (mv):	
800	800	800	800	Input Voltage: 10Vdc	
1,000	1,000	1,000	1,000	Max Load @ vdc:	
				Max Load @ vdc:	
				Shunt #: 821.0	

The above transducer was calibrated using a Chandler Dead Weight Tester S/N 21333 calibrated on 22 May 00 by an independent testing laboratory and traceable to N.I.S.T. Standards

SES Rep: <i>Napoleon Douglas Jr.</i>	Date: 24 May 00
Signed: <i>N. Douglas</i>	Recall: 24 May 01

*Note: Shunt # = (Shunt Calib Sensitivity/Full Scale Sensitivity)*Tranducer Range

Calibration Sheet

Manufacture: Dynisco		Model: PT130-1M	
Mfg. S/N: 05-17-007007		SES S/N:	
Output: 30mV		Transducer Range:	1,000 psi
Calibration Readings			
Applied Load psi	Reading 1 psi	Reading 2 psi	Reading 3 psi
0	0	0	0
200	199	199	199
400	399	399	399
600	599	599	599
800	800	800	800
1,000	1,000	1,000	1,000
Calibration Statistics			
		Zero Load Output (mv):	
		Full Range Output (mv):	
		80% Pressure Sensitivity (mv):	
		Shunt Calib Sensitivity (mv):	
		Input Voltage: 10Vdc	
		Max Load @ vdc:	
		Max Load @ vdc:	
		Shunt #: 801.0	
The above transducer was calibrated using a Chandler Dead Weight Tester S/N 21333 calibrated on 22 May 00 by an independent testing laboratory and traceable to N.I.S.T. Standards			
SES Rep: Napoleon Douglas Jr.		Date: 24 May 00	
Signed: <i>N. Douglas Jr.</i>		Recall: 24 May 01	

*Note: Shunt # = (Shunt Calib Sensitivity/Full Scale Sensitivity)*Tranducer Range

Calibration Sheet

Manufacture: Dynisco				Model: PT130-1M	
Mfg. S/N: 05-17-007008				SES S/N:	
Output: 30mV				Transducer Range: 1,000 psi	
Calibration Readings				Calibration Statistics	
Applied Load psi	Reading 1 psi	Reading 2 psi	Reading 3 psi		
0	0	0	0	Zero Load Output (mv):	
200	200	200	200	Full Range Output (mv):	
400	400	400	400	80% Pressure Sensitivity (mv):	
600	600	600	600	Shunt Calib Sensitivity (mv):	
800	800	800	800	Input Voltage: 10Vdc	
1,000	1,000	1,000	1,000	Max Load @ vdc:	
				Max Load @ vdc:	
				Shunt #: 802.0	
The above transducer was calibrated using a Chandler Dead Weight Tester S/N 21333 calibrated on 22 May 00 by an independent testing laboratory and traceable to N.I.S.T. Standards					
SES Rep: <i>Napoleon Douglas Jr.</i>				Date: 24 May 00	
Signed: <i>N. Douglas Jr.</i>				Recall: 24 May 01	

*Note: Shunt # = (Shunt Calib Sensitivity/Full Scale Sensitivity)*Tranducer Range

Calibration Sheet

Manufacture: Dynisco				Model: PT130-1M	
Mfg. S/N: 05-17-007009				SES S/N:	
Output: 30mV				Transducer Range:	1,000 psi
Calibration Readings				Calibration Statistics	
Applied Load psi	Reading 1 psi	Reading 2 psi	Reading 3 psi		
0	0	0	0	Zero Load Output (mv):	
200	199	199	199	Full Range Output (mv):	
400	399	399	399	80% Pressure Sensitivity (mv):	
600	600	600	600	Shunt Calib Sensitivity (mv):	
800	800	800	800	Input Voltage:	10Vdc
1,000	1,000	1,000	1,000	Max Load @ vdc:	
				Max Load @ vdc:	
				Shunt #:	798.0
The above transducer was calibrated using a Chandler Dead Weight Tester S/N 21333 calibrated on 22 May 00 by an independent testing laboratory and traceable to N.I.S.T. Standards					
SES Rep: <i>Napoleon Douglas Jr.</i>				Date: 24 May 00	
Signed: <i>Napoleon Douglas Jr.</i>				Recall: 24 May 01	

*Note: Shunt # = (Shunt Calib Sensitivity/Full Scale Sensitivity)*Tranducer Range

Four Commercial Street, Sharon, MA 02067, Tel: 617-784-8400

REFERENCE:

DATE: JUL 08 2000
 DYNISCO ORDER #: _____
 MODEL NUMBER: G830-300-1M-K73
 PRESSURE RANGE: 0-1000 PSIG
 SERIAL NUMBER 514434

ELECTRICAL INTERFACE:

CONNECTOR....PT02A-10-6P
 MATE.....PT06A-10-6S(SR)

TRANSUCER DATA:

ZERO LOAD OUTPUT: 0.010 mv/v
 FULL RANGE SENSITIVITY: 3.004 mv/v
 0% PRESSURE SENSITIVITY: 2.406 mv/v
 SHUNT CALIB. SENSITIVITY: 2.406 mv/v
 OUTPUT RESISTANCE: 358 ohms
 INPUT RESISTANCE: 389 ohms
 INSULATION RES. @ 50 vdc: >1000 megohm

A SIGNAL +
 B SIGNAL -
 C EXCITATION +
 D EXCITATION -
 E SHUNT CALIBRATION
 F SHUNT CALIBRATION

EXCITATION:
 6-10 volts 12 volt MAX
 TEST EXCITATION=10 vdc

MEASUREMENT EQUIPMENT TEST TECH:4507
 MAINTAINED CALIBRATED
 TRACEABLE TO N.I.S.T.

MODEL: G830-300-1M-K73

RANGE: 0-1000 PSIG

SER.#: 514434

TEST INPUT#: 2

DATE: 8 Jul 2000 _____

CALIBRATION:

REDUCED DATA:

INCR	OUT	%ERR	ZERO BAL:	0.010 mv/v
0%	(mv/v)	BFSL	F.R. SENS:	3.004 mv/v
	0.010	0.00	ACCURACY (BFSL):	0.08 %
20%	0.612	-0.06	ZERO NON RETURN:	0.03 %
40%	1.213	-0.04		
60%	1.815	-0.02		
80%	2.416	-0.02	IMPEDANCE:	
100%	3.014		OUTPUT RES:	358 ohms
80%	2.417	0.03	INPUT RES:	389 ohms
60%	1.818	0.08		
40%	1.216	0.06	SHUNT CALIBRATION:	
20%	0.614	0.02	80% SENS:	2.406 mv/v
0%	0.011	0.00	Rcal SENS:	2.406 mv/v
			Rcal ERR:	0.00 %



Four Commercial Street, Sharon, MA 02067, Tel: 617-784-8400

DATE:

JAN 13 2000

TE: _____

DYNISCO ORDER #: _____

DEL NUMBER: G830-300-5M-K73

PRESSURE RANGE: 0-5000 PSIG

SERIAL NUMBER 491733

ELECTRICAL INTERFACE:

CONNECTOR....PT02A-10-6P
MATE.....PT06A-10-6S(SR)

SENSOR DATA:

NO LOAD OUTPUT: 0.075 mv/v
 FULL RANGE SENSITIVITY: 2.988 mv/v
 % PRESSURE SENSITIVITY: 2.392 mv/v
 SHUNT CALIB. SENSITIVITY: 2.402 mv/v
 OUTPUT RESISTANCE: 365 ohms
 INPUT RESISTANCE: 403 ohms
 ISOLATION RES. @ 50 vdc: >1000 megohm

A SIGNAL +
 B SIGNAL -
 C EXCITATION +
 D EXCITATION -
 E SHUNT CALIBRATION
 F SHUNT CALIBRATION

EXCITATION:
6-10 volts 12 volt MAX

TEST EXCITATION=10 vdc

TEST TECH:4507

MEASUREMENT EQUIPMENT
MAINTAINED CALIBRATED
TRACEABLE TO N.I.S.T.

MANUFACTURED UNDER
A ISO 9001 QUALITY
SYSTEM APPROVED BY BSI

MODEL: G830-300-5M-K73

RANGE: 0-5000 PSIG

SER.#: 491733

TEST INPUT#: 1

DATE: 12 Jan 2000 _____

CALIBRATION:

REDUCED DATA:

INCR	OUT	%ERR	ZERO BAL:	0.075 mv/v
0%	(mv/v)	BFSL	F.R. SENS:	2.988 mv/v
	0.074	0.00	ACCURACY (BFSL):	0.10 %
20%	0.673	-0.07	ZERO NON RETURN:	0.02 %
40%	1.272	-0.03		
60%	1.869	-0.04	IMPEDANCE:	
80%	2.467	-0.02	OUTPUT RES:	365 ohms
100%	3.062		INPUT RES:	403 ohms
80%	2.468	0.02	SHUNT CALIBRATION:	
60%	1.873	0.09	80% SENS:	2.392 mv/v
40%	1.276	0.10	Real SENS:	2.402 mv/v
20%	0.676	0.04	Real ERR:	0.34 %
0%	0.075	0.00		



DEAD WEIGHT TESTER CALIBRATION CERTIFICATE

Technology and Calibration, Inc.

Dead Weight Tester Calibration Report

Manufacturer:	Chandler	Customer:	Stress Engineering
Model / Type:	Dead Weight Tester	Location:	Houston, Texas
Serial Number:	21333	Work Site:	Tech Cal, Houston
Cal Date:	5/22/00	Recall Date:	5/22/01
Report Number:	54902	P.O. Number:	306 TWA-DON 306 JWA-1
Capacity:	30000.0	Technician:	NLG, GRG

DIRECT COMPARISON BY CROSS-FLOAT METHOD

WT S/N	Compared Pressure	Standard Pressure	Error	WT S/N	Compared Pressure	Standard Pressure	Error
1	<u>1.00</u>	1.00	0.00	16	2000.00 ^{1000.00}	2000.00 ^{1000.00}	0.00
2	<u>2.00</u>	2.00	0.00	17	<u>2000.00</u>	2000.00	0.00
3	<u>2.00</u>	2.00	0.00	18	<u>2000.00</u>	2000.00	0.00
4	<u>5.00</u>	5.00	0.00	19	<u>2000.00</u>	2000.00	0.00
5	<u>10.00</u>	10.00	0.00	20	<u>2000.00</u>	2000.00	0.00
6	<u>10.00</u>	10.00	0.00	21	<u>2000.00</u>	2000.00	0.00
7	<u>10.00</u>	10.00	0.00	22	<u>2000.00</u>	2000.00	0.00
8	<u>10.00</u>	10.00	0.00	23	<u>2000.00</u>	2000.00	0.00
9	<u>50.00</u>	50.00	0.00	24	<u>2000.00</u>	2000.00	0.00
10	<u>100.00</u>	100.00	0.00	25	<u>2000.00</u>	2000.00	0.00
11	<u>100.00</u>	100.00	0.00	26	<u>2000.00</u>	2000.00	0.00
12	<u>100.00</u>	100.00	0.00	27	<u>2000.00</u>	2000.00	0.00
13	<u>100.00</u>	100.00	0.00	28	<u>2000.00</u>	2000.00	0.00
14	<u>500.00</u>	500.00	0.00	Piston	<u>50.00</u>	50.00	0.00
15	2000.00 ^{1000.00}	2000.00	0.00			0.00	0.00

*No Error Shown if Less Than Rated Accuracy

Instrument Performance Within Tolerance Rated Accuracy +/- .20% OR

Units Measured PSI As Found As Left

Remarks: Clean, Calibrate, and Certify.



Dead Weight Tester Certification

Issued To: **Stress Engineering
Houston, Texas**

Form # QCR-8.18
Revision A
Dated 06/01/98
Page 1 of 2

This is to certify that this pressure instrument/device has been tested and calibrated in accordance with Technology & Calibration's procedure, WI-8.18, Latest Revision with measuring instruments certified to N.I.S.T. traceable standards. Certified in accordance with ANSI/NCSL, Z540-1 and ISO 10012-1. This certification performed under Technology & Calibration's quality assurance program. All calibrations performed at 72 degrees F. plus or minus 4 degrees F. and less than 65% relative humidity. The collective uncertainty of the measurement standards does not exceed 25% of the acceptable tolerance for each characteristic of the measuring and test equipment being certified.

Manufacturer	Chandler
Serial Number	21333
Model / Type	Dead Weight Tester
Project Number	54902
Work Site	Tech Cal, Houston
Calibration Date	5/22/00
Recall Date	5/22/01
Verified Units	PSI
Verified Range	30000.0
Rated Accuracy	+/- .20% of Reading
P.O. Number	306 TWA-DON
Technician	NLG, GRG
Remarks	Clean, Calibrate, and Certify.

Standard Serial No.	Standard Manufacturer	Calibration Date	Recall Date	N.I.S.T. Traceable No.
15544	Ametek	03/26/99	03/26/01	822/256811
22028	Chandler	03/30/99	03/30/01	822/256610
13886	Chandler	03/24/99	03/24/01	822/256811

Calibrated By: **Chandler, Marklyn Lab., Inotek**

NOTE: This certificate shall not be reproduced except in full, without the written approval of Tech Cal.


Quality Representative

HYDRAULIC OIL SPECIFICATIONS


Chevron

Lubricants

Chevron Hydraulic Oil AW ISO 46

Typical Test Data

CPS Number	255674
MSDS Number	<u>7457</u>
ISO Grade	46
AGMA Grade	1
API Gravity	31.8
Viscosity, Kinematic	
cSt at 40°C	46.0
cSt at 100°C	6.7
Viscosity, Saybolt	
SUS at 100°F	238
SUS at 210°F	49
Viscosity Index	97
Flash Point, °C (°F)	218(424)
Pour Point, °C (°F)	-30(-22)
Fire Point, °C (°F)	
Oxidation Stability	
TOST, ASTM D 943, hr	>6000
RBOT, ASTM D 2272, min	
Color, ASTM D 1500	
TAN, ASTM D 974	
Rust Preventive, ASTM D 665	
Procedure A, 24 hr	
Procedure B, 24 hr	

Typical test data are average values only. Minor variations which do not reflect product performance are to be expected in normal manufacturing.

Specifications

API:

MIL:

OEM:

Cincinnati Milacron\P-70, Denison\HF-0/T5D, Denison\HF-0/T6C, Denison\HF-2, Racine Fluid Power\Model S, USDA\H2, Vickers\I-286-S, Vickers\35VQ25,

Vickers\M-2950-S

Source: IO-110
Last Edited by: LT-MTS

Revision Date: 7/14/00
Date: 07/14/2000



Material Safety Data Sheet

- Click on the product name to go to the Salesfax description sheet.
- Click on the grade to go to the Salesfax typical test data sheet.

Chevron Hydraulic Oils AW ISO 22, 32, 46, 68

MSDS: 7457 Revision #: 2 Revision Date: 09/30/99

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

CHEVRON Hydraulic Oil AW

PRODUCT NUMBER(S): CPS255673 CPS255674 CPS255675 CPS255676
 SYNONYM: CHEVRON Hydraulic Oil AW ISO 22
 CHEVRON Hydraulic Oil AW ISO 32
 CHEVRON Hydraulic Oil AW ISO 46
 CHEVRON Hydraulic Oil AW ISO 68

COMPANY IDENTIFICATION

Chevron Products Company
 Global Lubricants
 555 Market St.
 Room 803
 San Francisco, CA 94105-2870

EMERGENCY TELEPHONE NUMBERS

HEALTH (24 hr): (800)231-0623 or
 (510)231-0623 (International)
 TRANSPORTATION (24 hr): CHEMTREC
 (800)424-9300 or (703)527-3887
 Emergency Information Centers
 are located in U.S.A.
 Int'l collect calls accepted

PRODUCT INFORMATION: MSDS Requests: (800) 414-MSDS or (800) 414-6737
 Environmental, Safety, & Health Info: (415) 894-0434
 Product Information: (800) 582-3835

2. COMPOSITION/INFORMATION ON INGREDIENTS

100.0 % CHEVRON Hydraulic Oil AW

CONTAINING

COMPONENTS	AMOUNT	LIMIT/QTY	AGENCY/TYPE
LUBRICATING BASE OIL			
SEVERELY REFINED PETROLEUM DISTILLATE	> 98.00%	5 mg/m3 (mist)	ACGIH TWA
		10 mg/m3 (mist)	ACGIH STEL
		5 mg/m3 (mist)	OSHA PEL

The BASE OIL may be a mixture of any of the following: CAS 64741884,
 CAS 64741895, CAS 64741964, CAS 64741975, CAS 64742014, CAS 64742525,

CAS 64742536, CAS 64742547, CAS 64742627, CAS 64742650, or CAS 72623837.

ADDITIVES INCLUDING THE FOLLOWING

< 2.00%

ZINC ALKYL DITHIOPHOSPHATE

Chemical Name: PHOSPHORODITHIOIC ACID,O,O-DI-C1-14-ALKYL ESTERS, ZINC SALT
CAS68649423 < 1.00% 1 LBS CERCLA 302.4 RQ

COMPOSITION COMMENT:

All the components of this material are on the Toxic Substances Control Act Chemical Substances Inventory.

This product fits the ACGIH definition for mineral oil mist. The ACGIH TLV is 5 mg/m³, the OSHA PEL is 5 mg/m³.

3. HAZARDS IDENTIFICATION

IMMEDIATE HEALTH EFFECTS

EYE:

Not expected to cause prolonged or significant eye irritation.

SKIN:

Contact with the skin is not expected to cause prolonged or significant irritation. Not expected to be harmful to internal organs if absorbed through the skin. High-Pressure Equipment Information: Accidental high-velocity injection under the skin of materials of this type may result in serious injury. Seek medical attention at once should an accident like this occur. The initial wound at the injection site may not appear to be serious at first; but, if left untreated, could result in disfigurement or amputation of the affected part.

INGESTION:

Not expected to be harmful if swallowed.

INHALATION:

Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit.

4. FIRST AID MEASURES

EYE:

No specific first aid measures are required because this material is not expected to cause eye irritation. As a precaution remove contact lenses, if worn, and flush eyes with water.

SKIN:

No specific first aid measures are required because this material is not expected to be harmful if it contacts the skin. As a precaution, remove clothing and shoes if contaminated. Use a waterless hand cleaner, mineral oil, or petroleum jelly to remove the material. Then wash skin with soap and water. Wash or clean contaminated clothing and shoes before reuse.

INGESTION:

No specific first aid measures are required because this material is not expected to be harmful if swallowed. Do not induce vomiting. As a precaution, give the person a glass of water or milk to drink and get

medical advice. Never give anything by mouth to an unconscious person.

INHALATION:

If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.

NOTE TO PHYSICIANS:

In an accident involving high-pressure equipment, this product may be injected under the skin. Such an accident may result in a small, sometimes bloodless, puncture wound. However, because of its driving force, material injected into a fingertip can be deposited into the palm of the hand. Within 24 hours, there is usually a great deal of swelling, discoloration, and intense throbbing pain. Immediate treatment at a surgical emergency center is recommended.

5. FIRE FIGHTING MEASURES

SPECIAL NOTES: Leaks/ruptures in high pressure systems using materials of this type can create a fire hazard when in the vicinity of ignition sources (eg. open flame, pilot lights, sparks, or electric arcs).

FIRE CLASSIFICATION:

Classification (29 CFR 1910.1200): Not classified by OSHA as flammable or combustible.

FLAMMABLE PROPERTIES:

FLASH POINT: (COC) 302F (150C) Min.

AUTOIGNITION: NDA

FLAMMABILITY LIMITS (% by volume in air): Lower: NA Upper: NA

EXTINGUISHING MEDIA:

CO2, Dry Chemical, Foam, Water Fog

NFPA RATINGS: Health 0; Flammability 1; Reactivity 0.

FIRE FIGHTING INSTRUCTIONS:

This material will burn although it is not easily ignited. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.

COMBUSTION PRODUCTS:

Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

6. ACCIDENTAL RELEASE MEASURES

CHEMTREC EMERGENCY NUMBER (24 hr): (800)424-9300 or (703)527-3887

International Collect Calls Accepted

ACCIDENTAL RELEASE MEASURES:

Stop the source of the leak or release. Clean up releases as soon as possible, observing precautions in Exposure Controls/Personal Protection. Contain liquid to prevent further contamination of soil, surface water or groundwater. Clean up small spills using appropriate techniques such as sorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Follow prescribed procedures for reporting and responding to larger releases.

7. HANDLING AND STORAGE

DO NOT USE IN HIGH PRESSURE SYSTEMS in the vicinity of flames, sparks and

hot surfaces. Use only in well ventilated areas. Keep container closed.

Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner, or properly disposed of. Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:

Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS

Use in a well-ventilated area. If user operations generate an oil mist, use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below the recommended mineral oil mist exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

EYE/FACE PROTECTION:

No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.

SKIN PROTECTION:

No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances. Suggested materials for protective gloves include: <Nitrile> <Silver Shield> <Viton>

RESPIRATORY PROTECTION:

No respiratory protection is normally required. If user operations generate an oil mist, determine if airborne concentrations are below the recommended mineral oil mist exposure limits. If not wear a NIOSH approved respirator that provides adequate protection from measured concentrations of this material. Use the following elements for air-purifying respirators: particulate.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL DESCRIPTION:

Pale yellow liquid.

pH: NDA

VAPOR PRESSURE: NA

VAPOR DENSITY

(AIR=1): NA
BOILING POINT: NDA
FREEZING POINT: NDA
MELTING POINT: NA
SOLUBILITY: Soluble in hydrocarbon solvents; insoluble in water.
SPECIFIC GRAVITY: 0.86 - 0.88 @ 15.6/15.6C
VOLATILE ORGANIC
COMPOUNDS (VOC): <2.2 (wt.%); 19 g/l (estimated)
EVAPORATION RATE: NA
VISCOSITY: 22 - 61.2 cSt @ 40C (Min.)
PERCENT VOLATILE
(VOL): NA

10. STABILITY AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS:

No data available.

CHEMICAL STABILITY:

Stable.

CONDITIONS TO AVOID:

No data available.

INCOMPATIBILITY WITH OTHER MATERIALS:

May react with strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.

HAZARDOUS POLYMERIZATION:

Polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS:

The eye irritation hazard is based on data for a similar material.

SKIN EFFECTS:

The skin irritation hazard is based on data for a similar material.

ACUTE ORAL EFFECTS:

The acute oral toxicity is based on data for a similar material.

ACUTE INHALATION EFFECTS:

The acute respiratory toxicity is based on data for a similar material.

ADDITIONAL TOXICOLOGY INFORMATION:

This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B).

This product contains zinc alkyl dithiophosphates (ZDDPs). Several ZDDPs have been reported to have weak mutagenic activity in cultured mammalian cells but only at concentrations that were toxic to the test cells. We do not believe that there is any mutagenic risk to workers exposed to ZDDPs.

12. ECOLOGICAL INFORMATION

ECOTOXICITY:

The 48-hour EC50 for daphnia (*Daphnia magna*) is > 1000 mg/l (WAF).

ENVIRONMENTAL FATE:

This material is not expected to be readily biodegradable.

13. DISPOSAL CONSIDERATIONS

Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

14. TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT SHIPPING NAME: NONE

DOT HAZARD CLASS: NONE

DOT IDENTIFICATION NUMBER: NONE

DOT PACKING GROUP: N/A

ADDITIONAL INFO: Petroleum Lubricating Oil - Not Hazardous by U.S. DOT.
ADR/RID Hazard class - Not applicable.

15. REGULATORY INFORMATION

SARA 311 CATEGORIES:

1. Immediate (Acute) Health Effects:	NO
2. Delayed (Chronic) Health Effects:	NO
3. Fire Hazard:	NO
4. Sudden Release of Pressure Hazard:	NO
5. Reactivity Hazard:	NO

REGULATORY LISTS SEARCHED:

01=SARA 313	11=NJ RTK	22=TSCA Sect 5(a)(2)
02=MASS RTK	12=CERCLA 302.4	23=TSCA Sect 6
03=NTP Carcinogen	13=MN RTK	24=TSCA Sect 12(b)
04=CA Prop 65-Carcin	14=ACGIH TWA	25=TSCA Sect 8(a)
05=CA Prop 65-Repro Tox	15=ACGIH STEL	26=TSCA Sect 8(d)
06=IARC Group 1	16=ACGIH Calc TLV	27=TSCA Sect 4(a)
07=IARC Group 2A	17=OSHA PEL	28=Canadian WHMIS
08=IARC Group 2B	18=DOT Marine Pollutant	29=OSHA CEILING
09=SARA 302/304	19=Chevron TWA	30=Chevron STEL
10=PA RTK	20=EPA Carcinogen	

The following components of this material are found on the regulatory lists indicated.

PHOSPHORODITHIOIC ACID, O,O-DI-C1-14-ALKYL ESTERS, ZINC SALTS

is found on lists: 01,11,12,
SEVERELY REFINED PETROLEUM DISTILLATE
is found on lists: 14,15,17,

EU RISK AND SAFETY LABEL PHRASES:

May cause long-term adverse effects in the aquatic environment.

NEW JERSEY RTK CLASSIFICATION:

Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A.

34:5A-1 et. seq., the product is to be identified as follows:

PETROLEUM OIL

WHMIS CLASSIFICATION:

This product is not considered a controlled product according to the criteria of the Canadian Controlled Products Regulations.

16. OTHER INFORMATION

NFPA RATINGS: Health 0; Flammability 1; Reactivity 0;
HMIS RATINGS: Health 1; Flammability 1; Reactivity 0;
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

REVISION STATEMENT:

This revision updates Section 5 (Fire) and Section 12 (Ecological Information).

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

- | | |
|----------------------------------|--|
| TLV - Threshold Limit Value | TWA - Time Weighted Average |
| STEL - Short-term Exposure Limit | TPQ - Threshold Planning Quantity |
| RQ - Reportable Quantity | PEL - Permissible Exposure Limit |
| C - Ceiling Limit | CAS - Chemical Abstract Service Number |
| A1-5 - Appendix A Categories | () - Change Has Been Proposed |
| NDA - No Data Available | NA - Not Applicable |

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Toxicology and Health Risk Assessment Unit, CRTC, P.O. Box 1627, Richmond, CA 94804

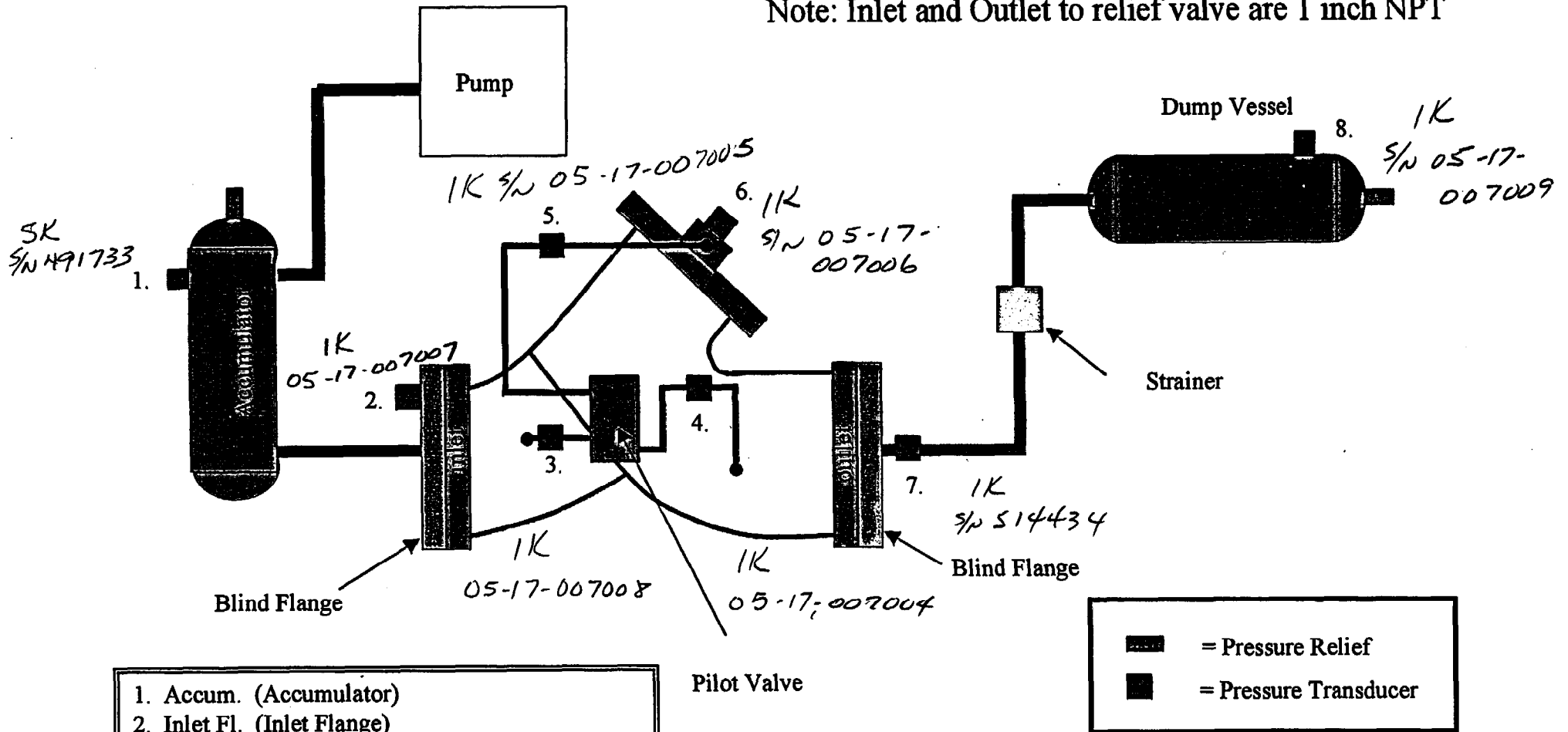
The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modification of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

THIS IS THE LAST PAGE OF THIS MSDS



TEST SET-UP INFORMATION

Schematic of Test Set-up

Note: Inlet and Outlet to relief valve are 1 inch NPT



- | | |
|----|--|
| 1. | Accum. (Accumulator) |
| 2. | Inlet Fl. (Inlet Flange) |
| 3. | Inlet PV SL (Inlet-Pilot Valve Sensing Line) |
| 4. | PV Outlet SL (Pilot Valve-Outlet Sensing Line) |
| 5. | PV CH SL (Cylinder Head Flange) |
| 6. | CH FL (Cylinder Head Flange) |
| 7. | Outlet FL (Outlet Flange) |
| 8. | Dump VSL (Dump Vessel) |

	= Pressure Relief
	= Pressure Transducer